

BULLETIN

OF

MISCELLANEOUS INFORMATION.

Nos. 125-126.]

MAY and JUNE.

[1897.

DLVI.—INSECTS DESTRUCTIVE TO CULTIVATED
PLANTS IN WEST AFRICA.

One of the difficulties inseparable from the work of opening plantations in new countries is the injury done to cultivated plants by various insects. In a state of nature these feed on the wild plants of the country and their attacks pass unnoticed. When, however, the indigenous forest is cut down to give place to regular plantations it is found that the insects whose food supply has been destroyed attack the introduced plants and cause considerable loss. This is inevitable under the circumstances, and is a part of the penalty which the planter has to pay for interfering with the balance of nature.

In West Africa the attacks of insects have of late been more than usually destructive. Numerous economic plants introduced for experimental cultivation at the Aburi Botanic Station, on the Gold Coast, have been almost entirely destroyed, while the newly established coffee plantations in the colony of Lagos have also suffered. Owing to the difficulty of obtaining satisfactory material and securing observations by skilled observers on the spot, it has not been possible hitherto to do more than offer suggestions for further inquiry and a trial of methods found useful in dealing with the attacks of allied insects in other countries.

At the instance of the Government of the Gold Coast, an inquiry has been undertaken on behalf of Kew by Mr. Walter F. H. Blandford, F.Z.S., F.E.S., with the view of identifying some of the insects, and of affording technical assistance in dealing with future attacks.

The correspondence which has led to the inquiry and Mr. Blandford's reports are detailed below. The information contained in these documents cannot fail to be of value to those who are engaged in cultural operations in West Africa:—

COLONIAL OFFICE to ROYAL GARDENS, KEW.

Downing Street,
August 29, 1896.

SIR,

I AM directed by the Secretary of State for the Colonies to transmit to you the accompanying copy of a despatch, with enclosures, from the Officer administering the Government of the Gold Coast, respecting the borers which infest some of the economic plants in the Botanical Station at Aburi.

I am to state that the Secretary of State will be obliged if you will be good enough to advise him as to the best method of dealing with these insects.

The Crown Agents for the Colonies have been instructed to forward to you the box of specimens mentioned in the despatch.

I am, &c.
(Signed) JOHN BRAMSTON.

The Director,
Royal Gardens, Kew.

ADMINISTRATOR of the GOLD COAST to COLONIAL OFFICE.

Government House, Accra,
July 18, 1896.

SIR,

I HAVE the honour to report that in consequence of the statements made by the Chief Justice, Mr. Brandford Griffith, in a letter addressed to Governor Sir William Maxwell, of which I enclose an extract, His Excellency requested the Chief Medical Officer to visit Aburi and make a report upon the condition of the coffee shrubs and rubber trees.

2. It was not, however, until last month that Dr. Easmon found himself in a position to leave Accra. I enclose a copy of his report which reached me on the 26th ultimo, and I am sending separately by this mail, addressed to the Crown Agents, a box containing—

- (a) specimens of borers; and
- (b) specimens of coffee trees showing the action of the borers upon them.

3. I have the honour to ask that Dr. Easmon's report and the specimens may be sent to the Director of the Royal Gardens, Kew, who will no doubt give his valuable advice as to the best method of combating and getting rid of the pest.

4. Mr. Humphries, the curator of the Botanic Station, who, I may say, afforded Dr. Easmon every assistance, is now, as you are aware, in England on leave of absence.

I have, &c.
(Signed) F. M. HODGSON,
Administrator.

The Right Honourable
J. Chamberlain, M.P.,
&c. &c. &c.

EXTRACT from a LETTER, dated Aburi, 6th January 1896, from the
CHIEF JUSTICE to the GOVERNOR.

I came up here on Saturday, and on Sunday morning I looked round the Coffee. It is in a deplorable state. The Arabian coffee apparently likes the soil and climate, but is literally ruined by (I think) a boring grub, which enters near the bottom and makes a hole rootwards, thereby doing fatal injury to the trees. Practically all the Arabian coffee looks wretched. I never saw anything looking better than the Liberian coffee. It looks superb. On closer investigation I found about two trees out of five attacked by a boring grub, different, I think, from the grub which attacked the Arabian coffee. This grub has only lately begun to attack the Liberian coffee, and you can see trees laden and

breaking down with fruit getting yellow from the effects of the grub; some are dying, some dead, all due to the boring grub. The natives see or will soon see it, and will abstain from planting coffee. Considering that this is an agricultural country, and that soil and climate appear to suit the Liberian coffee to perfection, something should be done to try and defeat the grub.

REPORT by DR. EASMON on some of the BORERS affecting some of the Economic Plants in the Government Botanic Station at Aburi.

1. *Borer affecting the Arabian Coffee.*

Specimens preserved:—

- (a.) Portion of cocoon showing its tough and fibrous nature;
- (b.) A full-sized grub or larva;
- (c.) A pupa; and
- (d.) A mature insect.

The larva is two inches long, greenish white in appearance with a darker grey streak along the sides; the head is large and provided with two strong brown nippers; the body consists of 11 segments, the two nearest the head being only slightly distinguishable.

Only a portion of the pupa is given; it calls for no special remark.

The developed insect is one inch in length; narrow body of a light brown colour; the head is black, on the centre of the back is a black triangular mark with the apex pointing backwards and on each side, about a quarter of an inch from the posterior extremity, are two smaller black marks. The antennæ are retracted over the back. This insect is very active in its habits.

2. *Borer affecting the Liberian Coffee.*

This is morphologically practically the same insect as that affecting the Arabian coffee; the matured insect seemed a trifle larger than the others and perhaps darker in colour, but I think this is simply a question of age or possibly of sex.

3. *The Castilloa elastica Borer.*

Specimens of this insect in various stages are supplied in two tubes.

The grub is much larger than in the preceding cases, and the matured insect is also larger, measuring $1\frac{1}{4}$ inches in length and much broader than the coffee borer. The antennæ are an inch and a half long and retracted over the body; the colour of this beetle is of a darker grey tint, with two small black points on either side of the middle line in the centre of the back, and black spots on the outer side of the body, as in the list described. This insect is most active in its operations.

4. *Orange and Lemon Trees.*

Two classes of borers affect these plants, one attacking them at the roots, the other at the branches. It would appear that the operations of the latter are dependent upon those of the former, and that as a matter of fact they are inoperative until a certain degree of diminished vitality of the wood is reached.

The root borers are particularly active, and the larva has special morphological arrangements for facilitating its operations. Specimens of all the insects I found on these trees are submitted.

(Signed) J. FARRELL EASMON.

ROYAL GARDENS, KEW, to COLONIAL OFFICE.

Royal Gardens, Kew,

June 29, 1897.

Sir,

WITH reference to your letter of the 29th August last, No. 17,220/96, and subsequent correspondence, I have the honour to forward herewith a copy of the report prepared by Mr. Walter F. H. Blandford, F.Z.S., on the insects injurious to plants at the Botanic Station at Aburi, on the Gold Coast.

2. The preparation of this report has, I regret to state, been unduly delayed by Mr. Blandford's engagement on the Natal Tsetse fly inquiry. The results of the investigation as now presented cannot, however, fail to be of considerable value on the Gold Coast, and as some of those destructive insects are widely distributed in West Africa, they will be of service in other colonies where coffee, india-rubber, orange, and other trees are now being cultivated.

3. Under these circumstances you may consider it desirable to communicate a copy of the report to the Governors of the other Colonies in West Africa in addition to the Governor of the Gold Coast, for whom it has been specially prepared. The small parcel sent herewith containing some of the insects named and mounted should also be sent to the Gold Coast, to be kept there for future reference.

4. It will be noticed that Mr. Blandford indicates somewhat technical lines of inquiry and methods of treatment. In the first instance these should be carefully studied and applied by the curators of the botanic stations, and the results of their observations might be placed on record for the information of persons engaged in cultivating economic plants, in occasional bulletins or in the annual reports of the stations

I am, &c.,

(Signed) W. T. THISELTON-DYER.

Sir JOHN BRAMSTON, K.C.M.G., C.B.,
Colonial Office, S.W.

REPORT by MR. WALTER F. H. BLANDFORD ON INSECTS injurious to
Coffee, &c., from Aburi.

MATERIAL RECEIVED.

The material received from Aburi consists of insects in various stages, preserved in spirit, and of samples of coffee shrubs, &c., which have been injured by them. Accompanying the material is a short report by Dr. J. Farrell Easmon, Chief Medical Officer.

It may be stated at once that the material and information supplied are insufficient to furnish the basis of a detailed report and fully set forth the measures to be adopted to relieve the plantations of these pests. In the case of, say, European insects of which the habits are tolerably well known, a mere identification of an injurious species is often sufficient to enable a line of treatment to be suggested.

In the case, however, of exotic insects it is only rarely that evidence other than that actually supplied with the specimens is available, and the utmost that can be done is to advise on general grounds, pointing out the direction which further inquiry should take, and the line of treatment which such inquiry, if it lead to a positive result, may suggest. This is all that can be done in the present case. The insects

sent from Aburi have been mostly identified, with some difficulty, but the identification has not led to the discovery of any literature dealing with their habits and economic features.

Nature of Insects sent.

The insects received from Aburi are all beetles, in different stages of development. They are divisible into two sets.

1. Longicorn Beetles.—One species of Longicorn beetle has been sent in each case as destructive to coffee, *Castilloa elastica*, and orange and lemon trees respectively. These appear to be the really injurious insects of the consignment.

2. Beetles belonging to the tribe *Heteromera*. With the exception of one species, taken by Dr. Easmon from orange and lemon trees, there is no evidence, direct or indirect, to connect any of these insects with the damage sustained.

It will therefore be convenient to consider the Longicorn beetles separately. Three species have been sent. They are:—

1. *Bixadus sierricola*, White, Proc. Zool. Soc. 1858, p. 310 (The Coffee Borer). Described originally from Sierra Leone. This insect has been sent as destructive to coffee, both Arabian and Liberian. Though Dr. Easmon seems doubtful on this point, there is no difference in the examples sent from either tree. The species attacks both kinds of coffee indifferently.

Bixadus is a sub-genus of *Monohammus*, a large genus of Longicornia, which contains two European species, *M. sartor* and *M. sutor*, both destructive to Coniferæ.

2. *Inesida leprosa*, Fabr. Syst. Ent. p. 178 (The Castilloa Borer). Described from Guinea and Senegal. This insect, familiar in collections of West African beetles, is the borer of *Castilloa elastica*.

3. *Eunidia* sp. (The Orange Borer.) This species is a small Longicorn sent as destructive to orange and lemon trees. But one example of the perfect insect has been received, which I cannot identify with any species in the British Museum collection. African species of the genus have been described from the Cape (1), Natal (8), "Caffraria" (5), Senegal (1), Angola (1), and Damaraland (1). The locality of the species sent is not far removed from Senegal; but it is impossible to identify it with the species occurring in that region, except after the examination of the type which cannot be seen.

The species of *Eunidia* are obscure and not readily determinable from descriptions.

General Habits of Longicorn Beetles.

The perfect insects of Longicorn beetles are usually rather sluggish, and are to be found by day on leaves, or on the trunks of trees, or logs. Sometimes they sit by day in the mouth of the burrows made by the larvæ. A few, chiefly of the smaller species, fly by day, but the majority fly at dusk or early in the night.

The female deposits her eggs, as a rule, in the cracks of bark, having an extensible tubular apex to the abdomen for that purpose. She does not pierce sound bark, but selects cracks, either natural fissures or cracks due to fungoid disease, wounds, &c. It is quite exceptional for a Longicorn beetle to lay on unbarked surfaces, and probably none of these species in question do so.

Several exotic species in both hemispheres prepare the wood for reception of the eggs by gnawing off a circular ring of bark round a branch. The part of the branch beyond the ring dies, and in it the eggs are deposited. This form of egg-laying is not shown, from the pieces of wood sent, to occur in the present cases, but it is important to know of its existence, as it is apt to be very puzzling whenever it is observed for the first time.

It is, I think, undeniable that Longicorn beetles will select perfectly healthy trees for oviposition, at least at certain times and in the case of certain species; but they are generally attracted to a tree by at least a local injury which affords a favourable spot for oviposition, and, in common with other wood-boring beetles, they generally prefer trees of which the health has deteriorated and especially those of which the normal flow of sap has diminished.

Causes leading to Selection of Trees for Egg-laying.

In any case of Longicorn injury, attention should be paid to the following points as likely to give some clue to the reasons which have led to the trees being selected for attack :

1. Antecedent injury by other insects especially extensive defoliation, loss of nutrition due to scale, blight, or other sucking insects; root-injury, by subterranean larvæ of different kinds such as chafer-grubs.
2. Fungoid disease, especially when attended with loss of foliage.
3. Drought, climatic or due to the presence of an unsuitable situation for planting.
4. Unsuitable soil, or soil deteriorated by over-exposure to sun, etc.
5. Imperfect root-growth, such as occurs when the soil-depth is too shallow and the roots meet with clay or the like.
6. Gross injuries from storms, wounds involving loss of bark, and the like.

These are some of the causes which lead to selection of particular trees. But inasmuch as these insects will habitually select sickly or overshadowed trees in preference to healthy ones, when they are not so numerous as to be restricted in their choice, it must be recollected that extensive damage to previously healthy trees is generally indicative of the species having been allowed to multiply and become overabundant in the situations which it normally selects for breeding. This multiplication is usually due to the non-removal of infested, sickly, and dominated trees, stumps, logs, and brushwood of kinds in which they will breed.

Freedom from their attacks can only be secured in situations where the trees are liable to them by strict attention to clean cultivation and the removal of all dead and dying material.

Characters of Longicorn larvæ.

The larvæ of Longicorn beetles are alike in general appearance and difficult to distinguish. They are soft and flattened, especially in front, white or pale, with a much-wrinkled thin skin. The head is short, transverse, black or dark brown, with powerful jaws, and is deeply sunk in the first segment of the body. This segment is broader than any of the succeeding, and is usually covered above with a somewhat rigid shield which protects it in burrowing. The body is flattened cylindrical after the enlarged one or two anterior segments, and is not tapering or fusiform. It is not curved ventrally, but is straight when the larva is

naturally extended. Legs are entirely absent, or present on the three anterior segments as six minute rudiments. Their place is supplied by tubercular enlargements of the sides of the segments, which, though soft, serve to give them a grip of the burrow.

Habits of Longicorn Larvæ.

The egg being laid as deeply in the crack of the bark as the parent beetle can manage, when the young larva hatches, it bores as a rule during the early part of its life in the inner layer of the bark and the outer sapwood. In these parts it excavates irregular galleries, which often intersect, and may lie in no particular direction with reference to the long axis of the trunk. *The galleries of Longicorn grubs are always transverse or flattened oval in cross-section*, corresponding with the transverse section of the larva at its largest part; this will distinguish them at once from the burrows of many boring insects. They are usually packed when fresh with fine wood-meal, the result of the boring.

The extent to which the galleries are bored superficially in the sapwood and bark varies greatly according to the species of Longicorn. In some the larva quits the surface-wood early to burrow in the heartwood, either up or down; in others all the boring is superficial, and the larva only enters the harder wood to make a chamber in which to pupate.

The greater the amount of this superficial boring, *the greater the injury to the life of the tree*; the greater the amount of boring in hard wood, *the greater the damage done to the timber as an article of commerce*.

With species that do a large amount of superficial boring, and especially when several larvæ are present in a trunk, large areas of bark may be detached from the sapwood, the nutrition of the tree is destroyed at these points, and the tree may be completely ringed underneath the bark.

When the larva is full-grown it changes to a pupa in a recess at the end of its burrow, which is packed in front and behind with a plug of wood fibre. The burrow is usually continued to the outside, with the exception of a thin layer before being plugged, so that the perfect beetle can emerge easily. The beetles themselves are not wood-borers.

It must be added that in most cases, and certainly in temperate countries, Longicorn larvæ, especially those which do much boring in the solid wood, are of slow growth, and may live for a year or more in that stage. Under exceptional circumstances larval life may be prolonged for many years.

It is hoped that the foregoing general account may be of assistance in supplementing the knowledge which has been gained of the particular species in question. Of these the coffee borer will be more particularly discussed, as the specimens of wood sent throw some light on its habits. It is to be regretted that these specimens were not forwarded with a little more information. In the case of one coffee shrub, of which the main stem and roots have been sent, cut into pieces, it has been found possible to put the pieces together and, with some difficulty, to work out the various systems of burrows traversing it. These will be briefly described, as a guide to further observations. It may be added that the only way of working out the systems of burrows in such a stem is to split the wood so as to expose all the burrows, and to paint colour along the margins of each burrow and its ramifications. If each separate

burrow is thus differently coloured, the general course of them ultimately becomes evident; but unless this is done, it is impossible to delimit each burrow without confusion, and yet such delimitation is very important for studying the facts of the case.

THE COFFEE BORER.

The stem sent measures about 2 ft. 6 in. from the collar upwards. The main roots are attached. It contains four burrows, made by not less than four larvæ.

About 2 feet from the collar is a large eroded patch about 8 inches long, extending nearly round the stem at its lower part. From this patch the bark is removed, and the sapwood is exposed and scored with shallow grooves due to the larval burrows.

Burrow 1.—At its upper part is a hole leading into the heart-wood, this communicates with a burrow running *down* the stem for 15 inches, and communicating with the outside part of the way down by a hole with callused margins, at the bottom it turns upwards and finishes in a pupal chamber communicating with the outside by a circular flight-hole through the bark. This burrow is *old*, as seen from its discoloured walls, emptiness, and the appearance of the flight-hole. It has been made and quitted some time before the stem was cut. At the point where it enters the heart-wood from the surface there is some callus, and it appears to me that the surface mischief caused by this particular larva had partly healed, and that most of the erosion in the patch from which the burrow starts was caused by the larva which had formed burrow 2.

Burrow 2 begins at the lower part of the eroded patch and runs *upwards* for 5 inches in the heart-wood to finish in a pupal chamber *without exit*. This burrow is a season, at least, later in date than burrow 1, and its course is largely determined by the presence of the latter. Its walls are not discoloured. As there is no exit hole to the burrow the terminal chamber must have contained the larva or pupa at the time the stem was split open.

Burrow 3 begins at a second large eroded barkless patch just above the roots, common to it and the next burrow; it is about 1 foot in length, runs deeply down into the rootstock and re-ascends to open at its upper extremity by a flight-hole. This is an old burrow, about the same age as burrow 1.

Burrow 4 begins at the large patch common to it and 3, and also runs down towards the roots; it is short, not above 4 inches in length, and turns back to open at a circular flight-hole some 4 inches above the ground. The hole is fresh. The remains of the pupal packing are in the burrow, which is later in date than 1 or 3, and probably coeval with 2.

Root gnawing.

Besides these four burrows, one of the roots has been extensively gnawed in patches. I am unable to trace any communication between these patches, which appear to be isolated in places from each other, and from any of the four larval burrows. It is a matter for question whether they are due to a Longicorn larva at all, or whether they have been caused by some underground grub, such as that of a weevil (*Rhynchophora*) or a chafer (*Scarabæidæ*) or by *Metallonotus denticollis* (p. 186). If such antecedent damage were to exist, it might be of the greatest importance in causing the state of health favourable to borer attack, and at the same time be easily overlooked.

Conclusions.

1. The shrub sent has been attacked by four distinct examples of Longicorn borer.

2. While the four belong probably to the same species—*Bixadus sierricola*—it cannot be proved that more than one species has not been at work.

3. The attack begins under the bark which is destroyed over large patches. *It is likely that while the attack is going on, these patches may be capable of detection by their altered appearance, exhibition of cracks or holes, which emit small quantities of wood-powder.*

4. The eggs may be laid near the ground, or at some height, 2 feet at least, up the stem. Possibly higher if the trunk is large enough.

5. Owing to the bark destruction, the points selected for egg-laying cannot be examined in the specimen.

6. The larval life is of some considerable duration, several months at least, probably over a year. The margins of the eroded patches are callused over, showing them (in the latter burrows) to be much older than the flight-holes.

7. The larvæ eventually enter the hard wood and may burrow up or down—if down, they ultimately turn back and bore upwards.

8. Of the four burrows, two are at least a season older than the other pair. The shrub is therefore not killed outright by the first attack, though it may be so injured as to be past recovery.

9. It is not essential that the larva shall bore into the roots. Its course is determined by the situation at which the eggs are laid, and by the presence of previous burrows.

10. One of the roots has been gnawed by an insect which I cannot satisfy myself to be a Longicorn grub.

One of the shrubs sent, which I took at first not to be coffee, as it was very different in appearance from the one described on page 182, has been apparently bored by a Longicorn which is *smaller* than *Bixadus*. In this case the borings are at the upper part of the stem, just below the axils; there is much superficial injury and loss of bark and not much boring in the hard wood.

I do not think this species can well be *Bixadus* because the burrows look too small. If not, if it is some other species, it becomes all the more important to differentiate its work, habits, and share of the damage from those of *Bixadus*.

Suggestions for further observation and treatment.

1. It should be placed beyond doubt whether the borer is capable of attacking trees hitherto uninjured (to any material extent) by other species of insects. Probably leaf-eating species, and scale, blight or the like would certainly have been detected, and may therefore not be expected to occur.

Root-feeding grubs should be looked for; either weevil-grubs or chafer-grubs.

Weevil-grubs are white and soft, like Longicorn larvæ, with a large horny head, a wrinkled skin and a horny plate behind the head. The head is not *sunk* in the next segment, the body is curved from end to end towards the underside, and is thickest in the middle. There are no legs.

Chafer-grubs are white or dirty-yellow, also pale and soft; cylindrical, doubled on themselves, very large and baggy behind; with a well-developed head and antennæ, and six well-developed legs.

If any other species of insects are found to be associated with or precede the Longicorns in the damage, they must be carefully investigated as to their habits, &c.

2. *The condition of the plantations attacked should form the subject of most careful examination* with a view to detecting anything amiss in the health of the trees or the conditions under which they are grown.

If some plantations in a district are immune, whilst others suffer, an examination of each set in order to find out any diversity of conditions which is associated with the variation in liability to attack should be thoroughly made.

On this point I cannot speak from botanical knowledge, but with that limitation I would venture to suggest the following points as being worthy of inquiry :

- (a.) The character of the soil;
- (b.) The depth of the soil, and nature of the subsoil;
- (c.) The water supply and drainage;
- (d.) The aspect;
- (e.) The condition of the plantation with relation to shade-trees.

I do not know if the Aburi coffee is grown under shade, but if not, the expedient of planting shade-trees should certainly be tried, with a view to lessen the attacks. In the severe infestation of coffee in Coorg by a similar boring Longicorn (*Xylotrechus quadripes*) there was a general opinion expressed by planters that the growing of the plants without shade-trees was detrimental to their health, caused the ground to become parched and favoured the beetle attack. Moreover a plantation with shade-trees is a "mixed growth"; and it is a general law that trees in mixed wood are less liable to insect infestation than in pure wood.

If on the other hand, the attacked coffee is already grown under shade, an examination of the shade-tree employed should be made to find out if it suffers from the same Longicorn borer as that attacking the coffee—if so it should be rejected in future in favour of some species of tree not so affected, and in plantations where it already exists it should be cared for and not allowed to become infested and breed out beetles freely, to migrate to the coffee.

If positive evidence is obtained that the infestation is favoured by any of the conditions of cultivation mentioned in this section, steps should be taken to modify those conditions in accordance with the experience arrived at.

3. Other indigenous trees should be examined to see if they are attacked by the same species of beetle. If this is found to be the case, such trees should be excluded from the neighbourhood of the coffee plantations. If this is done they should be removed, stumps and all, or the stumps earthed up. No stumps, logs, dead trees, or cut branches of coffee or any tree which serves as a host should be left about the coffee plantations. *All attacked plants which experience shows to be past recovery should be at once cut down, removed, and burned.* Probably careful attention to this matter will greatly lessen the damage.

4. The following points in the life-history of the borer should be accurately made out:—

The *season* at which the perfect beetles appear. This will probably stand in some relation to the dry and wet seasons.

The *habits* of the perfect beetles, their flight time, place of rest during the day; their tendency, if any, to frequent flowers, oozing sap, diseased trees, &c.

The *place* at which they *oviposit*. This is of importance. Probably oviposition is favoured by wounds in the bark. Special attention should be paid to the probability of the eggs being laid at pruning wounds, and the system of pruning adopted should be looked to with this object.

The *length of larval life* and the length of time a tree will withstand injury without succumbing should also be investigated.

The *early signs of injury* should be carefully made out, in order that infestation may be detected as soon as possible (*see* p. 183).

General Suggestions.

The following general suggestions for treatment over and above those already given are based mainly on the assumption that information will be gained on the above points in par. 4:—

Prevention of Egg-laying.

All pruning and accidental wounds should be tarred.

Possibly egg-laying may be prevented at the usual situations by plastering the part of the bark usually selected for the purpose with clay and cow dung, or a similar mixture, or painting it with lime-white mixed with rice water, to make it adhere. This treatment has proved successful with other species of borers.

Capture of the perfect Beetles.

This to be successful must be attempted after study of their habits and time of appearance. It may be done:—

(a.) By placing sheets under the bushes, and shaking off the beetles, in the early morning or whenever they are so sluggish as to drop. The beetles should then be collected and killed with boiling water.

A convenient plan of collecting them from sheets is to fit a tin bucket with a wide funnel-shaped lid of tin, furnished at the centre with a short tube. The sheets are shaken on to the lid, the beetles drop through the tin tube, and cannot escape until the lid is removed.

(b.) By setting baits for them, and collecting them from the baits. This cannot be done unless their habits show that some kind of bait will serve to attract.

(c.) By providing logs of any tree which they will attack, ringed trees, coffee shrubs which have been condemned and are dying or have been ringed for them to lay their eggs in. These "tree traps" should be provided before the flight period and removed before the beetles in them have bred out, or they will do more harm than good.

Preservation of attacked Shrubs.

This can only be done, if at all, by attentive examination so as to detect the early signs of injury when the larva is still feeding under the thin bark. That these early stages can be detected with practice I have little doubt; whether it can be done with sufficient rapidity to make it practicable is more questionable.

If such a patch is detected, the bark should be cut away and the larva tumbled out; it will soon die if exposed to the air and light. The cut part should then be tarred.

If the patch has been opened after the larva has finished its superficial burrowing, and gone deep into the wood, it might possibly be killed with a wire, or by wetting the burrow with kerosene, which will penetrate. But these methods are not very practicable, and I regard the surface burrowing as the most important.

With the exception of these methods the larval and pupal stages are not open to measures calculated to get rid of them.

The suggestions made in the foregoing pages cover all the points by which success in the treatment of the borer appears to me likely to be obtained. That they are all practicable under local conditions is unlikely; but they are all measures which have proved of service in other countries and with other host plants.

Particular attention is drawn to the necessity for investigating the antecedent causes which may have favoured the infestation, to the desirability of studying the relation of shade-trees to the infestation, to the great importance of destroying all woody material, shrubs, &c., which may harbour the larvæ and are past recovery, to the importance of attending to pruning wounds, and of catching the perfect insects by shaking down.

THE CASTILLOA BORER AND THE ORANGE BORER.

There is nothing to be said on these two insects which, *mutatis mutandis*, has not been said above on the coffee borer.

Dr. Easmon says "two classes of borers affect these plants, one attacking them at the roots, the other at the branches. It would appear that the operations of the latter are dependent upon those of the former, and that, as a matter of fact, they are inoperative until a certain degree of diminished vitality of the wood is reached." This is probable, and is in agreement with what has been suggested as possible, even if not likely, in the case of the coffee shrubs.

The Longicorn beetle, *Eumidia*, is the stem-borer, and its attack is therefore to be regarded as secondary.

Of Heteromorous Coleoptera (a tribe of beetles distinguished by the possession of five joints in the anterior and middle and four in the posterior pair of feet) Dr. Easmon has forwarded four species, all from decaying orange trees.

These species are as follows, the specimens are returned labelled, a more suitable arrangement for identification than the forwarding of a description:—

1. *Metallonotus denticollis*, Gray Griff. *Anim. Kingd.* II. 1832, pl. 80; Westw. *Trans. Zool. Soc.* III. p. 220. Described from Sierra Leone.

2. *Strongylium*, sp. indet.

3. *Selinus planus*, Fabr. *Ent. Syst.* I. p. 90, described from Sierra Leone.

4. *Lagria villosa*, Fabr. *Spec. Ins.* I., p. 160. Africa, widely distributed.

Nothing is known to me of the habits of these insects, and, with the exception of *Metallonotus denticollis*, it is likely that their presence on decaying trees is of no importance. They probably bear the same relation to the injurious wood-boring beetles as saprophytic do to parasitic fungi.

As far as can be gathered from the labels on the specimen-tubes sent the "root-borer" of the orange appears to be the larva of *Metallonotus denticollis*, accepting Dr. Easmon's identification of the larva with the adult beetle sent.

This larva is cylindrical-circular in cross section, entirely horny, dirty yellow, six-legged, the head brown, the eleventh segment of the body stouter, rough, and darker, shortly spined above on its hind margin, the last segment short, forming a transverse shield, hard and rough, with a marginal series of spiny tubercles and two hook-shaped spines projecting backwards.

I should doubt this larva being a borer in wood, as Dr. Easmon's account seems to suggest. It more likely burrows in earth like wire-worms and gnaws the roots.

There is no information at my disposal which will enable me to make any suggestions upon it. One or two species of its particular family (*Tenebrionidae*) have root-gnawing larvae, but very little is known about them.

The habits of the insect must be investigated, and speaking on purely *a priori* grounds, I would suggest that particular attention be paid to those of the imago itself. Root-feeding larvae are always difficult to get rid of by direct methods. But the imagos of *Tenebrionidae* are sluggish in many cases, and fly little. It might be possible to devise some method of attracting them, or some species of trap, such as is done for other non-flying beetles by means of holes, trenches, or ditches in which they will collect and from which they can be removed and killed.

Until further investigation is made, it is not possible to say more about this species. One species of *Bostrychus* (*B. iniquus*, Lesne) has been sent, in the form of a single example, from decaying orange wood. The *Bostrychidae* are often injurious wood borers; but it is reasonable to suppose that this species would have attracted attention if it were of importance. Its occurrence is probably accidental.

In addition to the insects injurious to coffee forwarded from Aburi, a small collection of insects has also been received from Mr. Cyril Punch, manager of the Soto Coffee Plantations, Colony of Lagos, West Africa. The specimens are accompanied with short explanatory notes.

Unfortunately, but very little can be said about these examples, which in most cases are not identifiable. Some particulars, which include the information given by Mr. Punch, are furnished in the hope that they may lead to further study of these insects in places where they occur.

1. PODURIDÆ.

A minute wingless insect, gen. et sp. incert, belonging to the family *Poduridæ*, which contains some of the very lowest insect forms. The species sent is about $\frac{1}{25}$ of an inch long. Mr. Punch describes it in the following note as an *Acarus*; it is, however, a true insect:

"Very troublesome all the year round to coffee. It affects whole clusters of berries, feeding on the developing ovules. The fully grown caterpillar is grey with black marks, very destructive to the leaf-buds. Colonies inhabit leaves folded together, and kept so by white filaments excreted by the caterpillars. The mites hatch both inside the berries and between the folded leaves."

The slide forwarded contains a dried example of what might be a very small caterpillar, but there is no connexion whatever between it and the

Podurid, as the note seems to imply. The *Poduridæ* undergo no transformation.

The only treatment that would be at all likely to get rid of the *Poduridæ* would be by spraying or fumigation, and it seems quite improbable that so much damage is done by this insect as to justify any such measures being taken.

2. ORTHOPTERA.

Brachytrypus membranaceus, Drury, is a very large species of cricket. Mr. Punch says of it: "This insect is present to some extent all the year round, but especially during February and March; also in August and September, but not in such quantities, nor do they cut the young plants to the same extent. Once in every five or six years they appear in such quantities as to be a pest as damaging as the locusts, destroying entire farms of succulent or young plants. Their galleries run down 18 to 24 inches, and terminate in a cell which will be found filled with the cut leaves and small stems. They are especially destructive to anything like coffee planted at even distances. Leaving the ground covered with weeds does not save the cultivated plants which they select. A space of three acres planted with rubber plants (*Manihot Glaziovii*) over which weeds were allowed to grow, had to be replanted three times this year."

In 1891, specimens of this insect received from the African Association, Limited, were reported on to the Royal Gardens by Mr. R. McLachlan, F.R.S., as follows:—

"The 'cricket' is known by modern systematists as *Brachytrypus membranaceus*, Drury (= *Gryllus membranaceus*, Drury, *Exotic Entomology*, 1773), and it appears to occur over the whole of tropical Africa. In 1804 Adam Afzelius in a pamphlet published at Upsala in Sweden, entitled *Achetæ Guinenses*, but which I have not seen, described it as *Acheta vastatrix*. Judging from the specific name its destructive properties had then already been recognised.

"It is not a 'mole-cricket,' but belongs to another section of the same family (*Gryllidæ*).

"As to remedial measures, I think much must depend upon the habits of the insect as observed by those in charge locally. Your suggestion as to irrigation sounds as if it might prove useful, by driving the insects above ground where they could be destroyed. Irrigating also by means of dilute paraffin, or the 'bisulphide' so much in vogue as a remedy against many injurious insects, might be tried.

"If the gravid female insects could be destroyed before they have laid their eggs, or if the very young insects could be got at soon after their appearance from the egg, much good of a preventive kind would be done. On these points almost everything depends upon the local observers.

"The insect no doubt does not confine its attention to any particular species of tree or plant, therefore constant attention will be necessary, or, at any rate, during a certain period in each year."

It is evident that this is particularly a case where more local observation is needed. It would be desirable to have further information on the following points: whether the adults fly; what the habits of the young are; whether they migrate on foot from place to place or injure the crop only where they are hatched. If the species is not migratory it might probably be met as Mr. McLachlan suggests, by irrigation, or possibly by digging trenches into which they can fall and from which they can be collected.

In the case of the mole-cricket the digging out of the nests with the young brood proves most satisfactory.

Should, however, the species migrate from place to place and travel on foot, it can probably be kept off any crop which is not previously infested, by surrounding the cultivated area with a ditch containing water and wide enough not to be jumped over, or, as is successfully done for the North American Western cricket, by fencing in the area with boards just so high that they cannot be jumped, and furnished on the outside with a tin "gutter," *i.e.*, a strip of tin nailed along the top so as to project obliquely outwards and downwards. Plants such as coffee can be protected by surrounding them when quite young with a tin can with the bottom knocked out, unless, like the mole-cricket, the insect burrows from below. This method is in use in Florida.

3. LEPIDOPTERA.

Caterpillars injurious to coffee :—Two species have been received in spirit from Mr. Punch, who writes of the first: "This caterpillar (A) is very destructive to Liberian coffee, but it entirely avoids the Arabian kind growing alongside. The eggs are attached to the underside of leaves. The caterpillars take about seven days growing to their full size; if left undisturbed they will strip the tree of leaves and green epidermis. Finally they fold themselves up in a leaf; the pupæ remain as such for about 14 days, and then turn into a grey-brown moth about $\frac{3}{4}$ in. long. I think the moth works at night, as I have never seen one free, only such as I have reared in boxes."

The eggs of this insect are oblong and are laid touching side by side in a characteristic ribbon-like band.

The full-grown caterpillar is some two inches long (exclusive of the posterior horn). The head is small and notched on the summit, the body is cylindrical, rather elongate and tapering behind, the first three segments behind the head are large and inflated, there are four pairs of prolegs in the middle of the body (segs. 6-9 exclusive of the head). The last segment bears a very long, slender backwardly-directed horn, $\frac{1}{2}$ in. or more in length, and the posterior prolegs (claspers) on it are aborted and rudimentary, so that the larva probably sits with its hinder portion raised in the air. According to Mr. Punch, the caterpillar is uniformly green when young, dull, with the swollen portion behind the head shining. When older it develops dark-coloured markings, the principal of these consist of a marbled pattern along the back, and a stripe on each side of the two hinder segments. The pupa is contained in a long thin cigar-shaped silk cocoon formed in a coffee leaf rolled up lengthwise.

It is not possible to identify this insect, as the moth has not been sent. Possibly it is one of the *Notodontidae*, or else allied to the true silkworm moth, approaching such a genus as *Tricula*.

The second caterpillar sent is a little smaller, not swollen behind the head nor tapering posteriorly, the hind claspers are well formed and the horn is smaller, sharper, and recurved upwards at the tip. It is lighter in colour, with a single row of small black specks along each side above the spiracles, its colour when alive has not been recorded by Mr. Punch, who says of it: "This caterpillar is of similar tastes, and while very destructive to individual trees is only found singly [? on scattered trees] and so is not so harmful."

No details as yet recorded of the life-history of these caterpillars give any clue towards treatment. On general grounds shaking-down,

or collecting the caterpillars, or spraying with an arsenical compound would suggest themselves, but the adoption of any plan must depend on local conditions and further study. Mr. Punch also writes: "The two beetles sent are enemies of the caterpillars and are, I think, increasing. They are furnished with beaks which they drive into the caterpillars and suck them dry, the dry skins being noticeable on the leaves. When many such skins are common it usually betokens a temporary cessation of the pest, which, however, breaks out again. There is no special time of the year for it. The pest started in the S.E. corner of the farm and spread it in a N.W. direction. Subsequent attacks have shown a similar tendency."

The "beetles" in question have proved to be examples of two species of bugs, Fam. *Scutelleridae*, many of which are well known to possess such habits. Unfortunately no effective way of increasing their numbers can be suggested. The facts as to the direction in which the pest spreads appear important, but their meaning can only be worked out on the spot.

4. COCCIDÆ.—Scale insects.

Two species of scale insect found on coffee have been sent by Mr. Punch. One is a species of *Ceroplastes*, with an irregular somewhat star-shaped waxy scale (test); the other is a *Lecanium*; the former appears to be of little importance but the *Lecanium*, according to Mr. Punch, may be injurious.

If any treatment against these scale insects is required and can be profitably undertaken, it must take the form of spraying with kerosene emulsion or some such compound.

5. SPECIES UNDETERMINED.

Mr. Punch has sent:—

1. Some minute larvæ which he says "cause ribbon-like marks on the upper surface of leaves, by running a gallery between the epidermis and the ground tissue. It apparently does no harm."

Beyond the fact that this leaf-miner appears to be dipterous, there is nothing to be said about it.

2. A series of small elongate narrow cocoon-like structures placed side by side and attached by their extremity to a piece of bark. These are shrivelled, hard, brittle, and homogeneous. The incomplete account sent with them states that "the pupæ adhere in lines as in the specimen to the vascular bundles. Layers are thus formed, closely imbricated, and on their development the stem is burst open longitudinally and the plant dies down to the place affected. At present four or five trees only have been affected, but while starting from the tree attacked last year, the radius of the circle of trees affected is wider. The fission of stems occurs in the months July and August. Usually the cell containing the insect opens at its extremity, but I note that those which have opened since leaving Africa have done so longitudinally. The insects in the slide have hatched since leaving Africa."

I am unable to determine what kind of insect has formed these cocoons, and Mr. Punch's account gives no clue. On the whole, it seems most probable that it is dipterous.

The insects referred to as having been hatched were present in the slide in some numbers. They are an extremely minute form, about $\frac{1}{50}$ of an inch in length, and at first sight resemble a thrips. The antennæ,

however, are not those of a thrips, but are elbowed and clubbed; the specimens are not preserved so as to admit of careful examination, but they appear to be a hymenopterous parasite, probably of the family *Mymaridae*.

Both the cocoons and the supposed parasites appear to be of some interest, and it is a pity that the scantiness of the material does not allow a more thorough examination to be made.

(Signed) WALTER F. H. BLANDFORD.

DLVII.—FRUIT-GROWING AT THE CAPE.

The following interesting paper on the possibilities of the fruit industry in Cape Colony has been communicated to Kew by the Government Botanist, Professor MacOwan. It affords a striking picture of the resources of a country where "all the fruits and crops of the warmer temperate zone grow to perfection." This information is supplementary to that already published in the *Kew Bulletin* (1888, pp. 15-19), and gives in an expanded form with greater detail the facts already given in the volume for 1893 (pp. 8-11).

"At the present moment there are in every direction openings for enterprise in various kinds of *petite culture*, openings such as have never existed here within the memory of man. It is not as if one had to speculate upon the chances of perishable produce being got across the line and placed upon English markets in saleable condition. But for everything that a man can grow to a moderate degree of perfection, there is an unfailing market just some forty or fifty hours distant from the coast, and the rail to expedite it all the way. It is said to be well for a man to have two strings to his bow. The up-country market is the Cape growers' first string, the export trade in fruit is the other. All the special appliances required for both lines of the enterprise are already provided. The steamship companies supply cold-storage on their vessels. A local firm has prepared refrigerating chambers for goods awaiting shipment. It would seem, therefore, that the only element required is an increase in the number of intelligent and practised growers. We want them from England, from the States, from California, in fact from anywhere where the skill and experience required has run for years into everyday practice. This is the immigration wanted just now at the Cape, to catch at the opportunity of the moment, and to turn skilled fruit-growing into gold. No question that success awaits the man who knows how to deal with fruit-trees, to break his ground up properly, to drain, to prune, to gather, to pack for market up-country, or for market in Covent Garden, and who has the well-founded contempt for the slovenly style of letting things grow themselves, and taking as a crop what chance seeds and insect plagues leave.

"Then you will say, Are there no growers at the Cape? Truly very few: here one, there one, but by no means sufficient to give a character to this magnificent country as a home of fruit-growing,—not sufficient even to lead by example the prevailing carelessness into better ways. The growth of fruit here has been almost always a by-thing, or what we might call a toy pursuit of the landowner. A few trees, mainly seedlings grown from pips and fruit-stones, planted in holes dug in the hard untrenched earth, unpruned and untended, except for an occasional drenching from

the furrow, used, generally speaking, to constitute a Cape orchard. So long as the owner had fruit for his own table during the season he was satisfied. The idea of growing fine choice fruits of named pedigree sorts in order to send them to market, attractively packed, so as to suit the dessert tables of well-to-do townsfolk who had no gardens, never entered his mind. Do you want fruit of him? Then you must buy it as a favour, and he would 'spare it to you,' and you certainly could not expect to get it twice, much less regularly through the season. Yet he would take the money, showing that the commercial instinct was not dead. The wonder is that so few ever turned to with a will, and put into fruit-culture the labour, energy, and forethought that go to make a successful business. Things are a little better now. There *are* a few men, three times as many as there used to be, who now grow fruit to the perfection possible in this perfect climate, and all they send to market is eagerly bought up either for local consumption among the higher classes or for export to England. But they may be counted on one's fingers, in place of being numbered by hundreds, and scattered all over the country. Then you will say, With what is the ordinary market supplied? Truly with fruit of the poorest quality—the product of seedlings instead of grafted trees—bastard refuse, without a name and without a single quality to recommend it. It looks as if it had grown itself, and this it mostly has. The ruling condition of the fruit, such as it is, is worsened by utter ignorance of proper packing and transit. Much of it is shaken down and tumbled into old paraffin cases and jolted to market in a springless waggon. Hence it must be picked only three-quarters ripe, so as to bear the rough usage without being turned to unsaleable pulp. One would think that the example of the few leading men aforesaid, and the high prices they pull off for their exceptional samples, would be sufficient to start a reform, but there are several causes operating in the other direction. There are the antiquated conservative ways of the small farmer at the Cape, arising out of the comparative isolation in which he lives, and which only has been broken in upon this last year or two by the establishment of fruit-growers' associations in their very midst, through which an effective interchange of ideas has been brought about, and information given upon the subject of their special industry. Till these excellent associations sprang up, mainly through individual activity and personal influence, it was difficult to find a market gardener who took in a garden periodical, or cared to learn what was done in other countries. Another cause materially checking the desire to improve the output is the immense demand that exists for cheap coarse fruit and windfall rubbish among the coloured populace of Cape Town. To them, so that the fruit is dirt cheap, it does not matter how dirty it is, nor are they disgusted at seeing the same baskets which brought the fruit to town piled up among the stable manure the cart takes back in the afternoon. In no other public of fruit consumers is quality so little thought of, and hence the producer has been satisfied to grow crops from seedling trees which are only fit for stocks. They sell somehow, so why should he trouble himself to produce a better article? However, things are on the mend. It may be a long time before really good or even middling fruit reaches the level of the street hawker, but the simple fact that the great market of Johannesburg discriminates keenly between good and bad, and pays accordingly, must inevitably react on the producer, and even more directly persuasive are the perpetual calls of the fruit agent concerned in export to Covent Garden. He knows good fruit at sight if anyone does, and his determination to have it grown clean, ripened exactly to the export point, gathered

delicately, and graded to size, will do more towards teaching fruit-culture than a legion of experts.

"It is, therefore, just at this critical stage of matters that the English fruit grower who now despairs of making profits at home is invited to come to the Cape and take his opportunity by the forelock. It is a pity, too, that the foreign capital which comes Capewards goes mostly into mining stock. It were well if some of it were invested in the healthier industry of fruit-culture. Perhaps ere long the one or two companies which have already got into working order will form an example to other companies and friendly competitors in a trade which is practically illimitable.

"We have said that all the material appliances for a growing export fruit trade have been initiated here. It is not therefore as if newcomers, throwing their practical knowledge and their little capital into Cape fruit-growing, would find difficulties in the outlet for their produce. Let it be remembered that the Cape has one signal advantage for fruit supply to European markets which is not conceded to the clever and enterprising American grower. *The seasons fall conversely with those of England.* Consequently the only competitors in our special line and special time of exporting will be the Australians, who, however, are heavily handicapped by a one-third greater distance from England.

"This general arrangement must not be taken too absolutely. The seasons on the two sides of the Colony, west and east, are differentiated much as are those of India, by the rainfall occurring conversely. In fact, the Cape is a monsoon country, the west having its maximum rainfall in winter, while the east has it in the warmer months. There is this peculiarity also in the east, that there are two maxima, namely, the November or spring rains, and the autumn rains in February.

"From these peculiarities arise important results in fruit-growing. The most striking is the ~~the~~ limitation of uniformly profitable wine, grape, and raisin production to the Western Province, which possesses the necessary hot and dry summers for the proper ripening of the fruit of the vine. In the east, with its dispensation of summer showers and frequent hailstorms, with much heavy rain in February, viticulture is reduced to a branch of gardening, and it is questionable if anything more than table grapes for local consumption, such as the *Crystal* and *Sweetwater*, can be successfully managed. Of course this is a general statement, subject to here and there an exception, dependent upon climatic conditions. For example, good results have been obtained in the somewhat intermediate climate of the Karoo, particularly at Graaf Reinet and its neighbourhood. The total rainfall throughout the Karoo averages low, say 16 to 19 inches annually, as compared with 28 to 30 inches in the normal eastern region. But the rule holds good in a general way, and a glance at Gamble's diagrams of rainfall, where the curve is plotted for a large number of places, so as to be readily comparable by the eye, will enable one to determine where viticulture on a large scale is climatically favoured, and where it will present special difficulties. In the former case the rain curve for January, February, and March—the ripening and vintage months—keeps at or below 1 inch; in the latter it runs up to the monthly maximum for the year, say 3·5 to 4 inches. The Sunday's River valley upwards from the Addo, and also perhaps the hot sheltered environs of Uitenhage, are the best examples of local eastern exceptions to the general rule. But even here grapes will have to be tended with very much greater care

and intelligence than seems to be necessary westaway. The great difficulty will assuredly be the general prevalence of anthracnose, or black-spot, as it is sometimes called (*Sphaceloma ampelinum*, De By). This plague, though far from being comparable in mischief to the *Peronospora* of the vine, which luckily we have not yet imported, is still an enemy to be reckoned with, and it will be necessary that all eastern vineyards be assiduously treated by spraying with Bordeaux mixture as a preventive of the scourge. There is little doubt that success will attend the proper application of this remedy, just as has been proved to be the case in Europe. But the additional charges for skilled labour in its use will heavily handicap the eastern producer, especially if he should incautiously cultivate the more delicate varieties of vine, say, for instance, the Cape western Haanepoot, known elsewhere as Muscat of Alexandria, a sort which is particularly liable to the attacks of Anthracnose.

"New comers to a country who have been accustomed to the class of grape which is seen upon English dessert tables, will be surprised to find that nothing has ever been done at the Cape at all comparable to the minute care which grapes receive at home under glass at the hands of skilled gardeners, who have made this fruit a special study. As we have them, the grapes are fairly good, and up to size on the outside of the bunch, but, by carelessness and want of proper thinning, they are not half-grown or half-coloured in the middle. The plan has been to grow grapes for wine and for the table in the same vineyard, and with the same low average of attention. That is to say, the table grapes have practically grown themselves, instead of each bunch having been the subject of individual inspection and treatment with the thinning scissors. Perhaps some skilled gardener, who knows what a dessert bunch of grapes should look like, may find it worth while to show what can be done in this country, where the climate renders his glass-house and hot water pipes unnecessary. Certain it is there is no lack of wealthy folk here who will buy grapes of English hot-house type at their full value. *Mutatis mutandis*, much the same thing may be said of other fruits, peaches and pears particularly. Our growers have had no high standard to work up to, and have been too easily satisfied. The comments of Covent Garden salesmen upon picked Cape samples have certainly opened their eyes somewhat, and given them to see that the fruit which has been taken as first rate, levels down to scarce a second place when put beside first-class produce skilfully grown at home. We have taken things too easily, and left too much to nature, forgetting that the finest type of fruit is decidedly a product of art, for which nature provides only the raw materials.

"In western markets, January gives the last of the strawberries and apricots which have been to hand for some five or six weeks previously. The earlier sorts of grapes, pears, and apples according to kind, also the earlier peaches, plums, and figs, fill up the list. From the conditions of the climate it is rather a cultural mistake to try and hurry things by planting what are known in Europe as early-fruit sorts. Cape conditions are much more favourable to perfection in the later kinds, at least in such parts of the country as lie upon the first plateau reaching inland all round the coast. Further up-country on the narrow second and the immense third plateau, which reaches a level of approximately 4000 to 5000 feet, the conditions are considerably altered. But the gain expected from the growth of early sorts at this level is practically interfered with by the tardier approach of spring and persistence of a dry winter's cold. The results of the most experienced cultivators

is decidedly against experimenting with early sorts in the hope of catching the high prices asked in an early market.

"In February the better sorts of apples, peaches, and nectarines come forward; and a glance at these will show conclusively that they are mainly late European varieties, and accentuate the caution we have given against early sorts, at least for market supply on the large scale. Grapes and melons are becoming plentiful, and begin to acquire their proper distinctive flavour, unless they have, as is often the case, been spoiled by injudicious irrigation. The fruits of keeping quality are now approaching the season for picking. As a rule they are left too long upon the tree for want of two things,—first, want of practical knowledge of the precise degree of growth at which to take them, so that they shall best develop the richness and flavour that come by keeping; and second, want of something like a reasonable fruit store, where they can be laid out properly, inspected daily, and kept at even temperature. It is pitiable to see good keeping sorts huddled up in boxes, a bushel or more together, in a galvanised iron shed open to the light and the weather, and varying in temperature daily from 80° to 90° at noon to 48° or 50° at night. This is another matter in which we want some gardening missionary to come over and teach us a gospel of better things.

"In this month and in March begins the first drying season,—that is to say, fruit-drying in the sun, as opposed to fruit-evaporating, the more practical, more cleanly, manageable, and time-saving plan. Already very fair work of this kind has been done, and the Wellington dried fruits have quite fetched up to the already high standard of the raisins produced in the Worcester district. The only reason why these products are unknown outside the boundaries of the colony is that the amount produced does not bulk large enough, and that they are almost entirely consumed locally in the colony. The output is not a hundredth part of what it should be, and what could readily be absorbed by the Cape consumer. Hence in this case, as in so many others, we stand in the somewhat absurd plight of possessing the finest country in the world for production, and yet being content to allow ourselves to be served by manufacturers and dealers who grow and fetch and carry for us away on the other side of the world. How long this anomaly is to continue, and a Cape rural population is to think it no shame to have on their tables American dried apples and peaches, and positively to import American fruit pulp wherewith to make "Cape jams," rests with the coming race of fruit-growers whom we hope to attract to the country and help us to put a little life and stimulus into our easy-going, lotus-eating lives. Do not for a moment suppose the thing is here put sarcastically or in an exaggerated manner. The whole output of first-class Worcester raisins was last year bought up, as a matter of course, by *two retailers* in Cape Town. The year before the same buyers collared it all. Is it not clear that our production has yet to expand itself into wholesale proportions? Another retailer, on examining an exceptionally good sample of dried figs that ran the imported 'Elemi' article very close, offered the producer an Elemi price. Picture his disgust on being advised that the total stock produced that year amounted to only *six* boxes. And so with the prunes. We are content to buy continental jars of 'Prunes d'Agen' and 'Prunes d'Ente' year after year, forgetting that no better prune-growing land than this exists on the face of the earth. Truly, in face of such facts as these, one does not know whether to laugh, to cry, or to swear. But one thing is certain, that with present conditions at the Cape, with family grocers buying up all the raisins that a whole district produces, with farmers content with a

dried fig crop which a man could carry on his shoulder, there must be a good many fair fortunes lying about loose at the Cape, and only waiting for some one with moderate commercial instincts, industry, and business capacity to come over and appropriate them to himself.

"March, of all the months of the year, shows the barest fruit market, at least in the way of fresh kinds putting in an appearance then. The supplies are chiefly late apples and pears of the keeping sorts, and these, when they come to sale, bear plentiful testimony to the rough way in which they have been handled and stored. The outside skin is scratched, discoloured, and far from appetising. Ere long the dealers will learn that fruit ripened in the storehouse must receive attention and handling somewhat different from that which is accorded to the year's crop of potatoes. A few peaches of late kinds come in and generally secure good prices. For the most part these are seedlings that have originated here many years ago, and, though fairly good, belong unfortunately to the series of clingstones. There is an opening for considerable improvement by selection of the improved modern late freestones. In all these fruits the variety of sorts presented on the market is very limited, and the knowledge of named kinds is generally absent. It is impossible to go to any retail dealer and ask for a Bon Chrétien or Ribston Pippin apple. The seller would simply gaze at you in astonishment as if you were speaking a foreign language. All this will have to be changed, and no doubt with a continued demand for fruits by name the dealers will gradually learn something more about the details of their trade than at present they seem to think at all necessary. The month closes with the last of the grapes.

"April, May, and June present few novelties. The guavas of many seedling kinds fill up a place which is hardly warranted by the intrinsic value of the fruit as at present grown. We have them from the insignificant bulk of a gooseberry to that of middle-sized apples. But very little attention has been given to culture, and still less to improvement of sorts. It may be said that the guava, as grown here, is often practically a wildling, and it would be well if nineteen out of twenty of them were destroyed, and selected grafted plants put in to take their place. Some day we shall get rid of the mass of bony seeds which fills up the centre of the market guava, and shall aim at making it a more presentable fruit. Walnuts and chestnuts now make their appearance. The former have not received fair play. They, too, have been propagated in our careless Cape way by seedlings, and it is only within the last twenty months or so that the fine imported sorts, in which the French growers have had such success, have been brought into the country. The remainder of the supply of these months is from Natal, whence our market is flooded with small pineapples and bananas. The former are remarkable for being nearly all outside. Of late, a slight improvement has been observable in the quality of these fruits; and when the matter comes to be inquired into, it is found that nearly all the finest fruit, classed roughly in the popular idea as Natalian, turns out to be the product of a few recently established plantations along our own eastern coast. There can be little doubt that this industry will increase year by year to very considerable dimensions. The growers have begun the proper way, namely, by discarding the small, hard-skinned, and half-grown wildling pine, that has so long been foisted upon us, and going to Ceylon and the West Indies for the very best sorts procurable. From this source, too, will be obtained large supplies of the Cape gooseberry (*Physalis*), which is perhaps the most delicious fruit for canning and preserves that the whole world has to show. We have been accustomed to despise it, simply because it

grows wild without care or culture. The jam factories are, however, already increasing their output of it, and making it worth while for people to undertake its production as a *petite culture*.

“With the last days of June and the first of July come in the whole tribe of citrus fruits, orange, lemon, naartje or tangerine, and pamplemousse. From the variations of climate and altitude which have been signalised at the beginning of this article, it follows that these fruits hold their place on the market continuously till December, their peculiar external character and power of ripening up after gathering rendering them comparatively easy of transport from long distances. The locally grown fruit is perhaps at its best in October,—that is to say, it can then be picked and marketed perfectly ripe, instead of gathering it green and trusting it to slow ripening in the store-room. Perhaps in the case of no fruit more than these has the public mind been so thoroughly awakened to the necessity of improvement, and discarding the wretched seedling rubbish, full of pips and cased in the thickest of skins, which has for many years encumbered our markets. The importations of good grafted trees of the best sorts have been very numerous; and if the cultural conscience can only be aroused to the necessity of a vigorous crusade against the scale-insects, which up till now have had it all their own way, and also the necessity of giving orchard trees something like fair play and reasonable care, there will be amongst us quite a new era of citrus fruit-growing. The great desideratum is that the spirited proprietor shall himself grow the oranges, instead of leaving them to grow themselves. At present our largest supply, in Cape Town at least, comes from Natal, and it is not particularly good. The best Cape grown oranges are from the district of Clanwilliam.

“October brings with it the Japanese loquat, another fruit which calls for selective improvement. There is as yet far too much pip and too little flesh upon the ordinary loquat. Yet there have arisen in several private gardens seminal varieties showing a commencement of better things. These should certainly be increased by grafting, as far as possible, instead of reverting to the chance seedling mode of getting new trees.

“With November come in the earlier figs and the strawberry. There is a future for the fig, and its selected Cape home and centre of drying for commercial purposes will probably be somewhere in the Karoo. It is true that we have not, native, any insects similar to the *Blastophaga*, which assists in the perfecting of the celebrated Smyrna fig. But in these days of quick steam communication it is not impossible to introduce this useful insect, just as we have successfully acclimated the *Vedalia*. As to strawberries, the selection of sorts, grown chiefly at Stellenbosch, is very limited, and modes of culture anything but modern. As a rule, the beds are allowed to continue production for far too many seasons, and the fruit consequently deteriorates, losing both size and succulence. New blood and new ideas, with the habit of modern practice in strawberry-growing, as it is done in Kent and Surrey for the great London markets, is very much wanted at the Cape. The demand for the fruit is practically unlimited. The month closes with the early apricots, and this delicious fruit queens it right through December. If our growers would only learn the first principles of pruning this far too generously growing fruit tree, keep its bountiful nature well under control, and thin its bearing to something like one-half, then truly would the Cape have such apricots as no other place in the world could show.

“Whoever reads this little *resumé*, and begins to turn over in his mind the idea of coming out to the Cape to utilise there his practical knowledge

of European fruit-growing, will naturally ask what conveniences already exist in the way of supply of orchard stock. Every practical man would hesitate to bring out with him a lot of grafted trees, selected as best he could, for a country he had not even seen, and of whose climate and soil he had had no experience. But very recently there have been introduced into the Colony large numbers of the very best modern fruit-sorts of all kinds, by men who have themselves practically learned the capacity and conditions of the Cape as a fruit-growing country, and it is not too much to say that, by their industrious multiplication of these picked kinds, the market for first-class orchard stuff is now amply supplied. There is no reason now for continuing the old system of seedlings, unless out of pure wrong-headedness and refusal to take up with improved methods. So friendly is the climate here to the skilled manipulations of the nurseryman, that first-class grafted yearlings can be obtained at prices not greater than those ruling in England, and thoroughly reliable to name and graft-stock. To import for oneself on coming out to the Cape would certainly involve the loss of a season, to say nothing of difficulties in the way of immediately finding ground wherein to set out the consignment. Immigrants of the kind one would so gladly see spreading themselves over the best districts of the Colony, each with his market-orchard grown and tended in the way that means business and sound profits, would be wise not to start at once, but to spy out the country first for themselves, and for themselves see what our grapes of Feshcol are like, take stock of us and our little old-fashioned ways and conservative habits of working, and then only, when the land was no longer strange, and the altered climatic conditions have become familiar, to exploit their capital on some selected fertile piece of land, and add to the wealth of their adopted country by successfully adding to their own.

“A brief memorandum like the present cannot by any means give all the information that an English fruit-grower would find useful when he is thinking of looking out for fresh fields and pastures new. It would be well to note carefully the details to be found in the *Illustrated Handbook of the Cape*. But perhaps the best idea of the way cultural matters go on here, and the peculiar conditions of Cape rural life, would be obtained by consulting the issues of the *Cape Agricultural Journal*, now in its ninth volume. At the basis of all calculations lies the fact that the Government, unlike those of Australia and New Zealand, have no available acreage out of which they can make free grants to new-comers, and this is simply because the Colony dates back some two centuries before the time when the sister Colonies began to be exploited by the intrusive European. All available land, at least within colonial boundaries, has long ago been taken up, and is in private possession. Purchase or tenancy at a moderate rent is therefore a prime factor in all forecasts of new cultural ventures. Suitable land, even such as has never felt the plough, but is simply sat upon by the proprietor, and goes with his pasture area, would sell at about 10*l.* per morgen of two acres, provided it were within easy reach of a market by railway. The rent would perhaps be 10*s.* to 12*s.* per morgen. Mere wheatlands would fetch very much less, and if distant from the railway might perhaps be valued at 12*s.* to 20*s.* per morgen. Mashonaland certainly offers unlimited scope, but its market is yet to be made. Also it is only near the larger centres of population in the south-west that labourers can be found who have even a small degree of skill in the ruder operations of cultural work. Coloured men, the descendants of the old slave population, with a considerable amount of miscegenation, can be relied upon to

trench, dig, and hoe orchard and vineyard, to plough and harrow, and to give the vines their annual prunings, and some of them have even recently learnt to graft with fair success. Of course all this is subject to a vigilant supervision, and subject also to the fact that the labourer's wants are so very few as to make him somewhat independent. He therefore favours his employer by working, when he is in the mind, at half-a-crown per day. The better men readily get another shilling, and are a good deal sought after. Mere farm labourers receive 25s. per month, with rations for self and family. As a rule these last are perfectly unreliable, and are unacquainted with the use of other than the simplest hand tools.

"In conclusion, it is highly advisable for any one intending to try fruit-culture at the Cape to bank his capital on arrival, and arrange to receive the colonial rate of interest, meanwhile seeking out a situation with some one who is already owner of the land upon which he lives. This would be the best course, even if no salary and nothing but board were offered in the way of remuneration for services rendered. In a short time experience in Cape ways and Cape seasons would thus be gained, and the land spied out. It is much after this fashion that the best and wealthiest farmers among us have worked their way in and up. The European coming from an English farm and making a beginning without local knowledge, has much to learn and unlearn, or he will inevitably come to grief in a few years. And what is true of the larger venture of farming is even more certain with the somewhat more refined economy of the orchard.

"The following details as to the export of fruit from the port of Cape Town during the season of 1894 is drawn from the Customs returns. It is impossible to say accurately what proportion this bears to the quantity sent up to the ever ready market of the Transvaal, but in the opinion of those qualified to judge it has already been tripled or quadrupled.

RETURN OF FRUITS EXPORTED DURING THE SEASON 1893-94.

Sorts of Fruits.	December.	January.	February.	March.	April.	Total.
Apples - - -	—	—	89	41	50	180
Apricots - - -	12	12	—	—	—	24
Gooseberries - - -	—	—	1	—	—	1
Grapes - - -	—	443	3,139	1,800	901	6,283
Grenadillas - - -	—	1	—	—	—	1
Melons - - -	—	4	113	—	—	117
Nectarines - - -	—	4	19	—	—	23
Pears - - -	—	—	175	164	43	382
Peaches - - -	—	530	46	—	—	576
Pineapples - - -	—	—	—	7	—	7
Plums - - -	—	—	1	—	—	1
Quinces - - -	—	—	—	30	1	31
Tomatoes - - -	—	13	43	1	—	57
Total packages -	12	1,007	3,626	2,043	995	7,683
Declared value - -£	4	182 7 6	784 9 0	476 6 3	274	1,721 2 0 ¹²

DLVIII.—CANAI GRE.

(Rumex hymenosepalus, Torr.)

The history of this new tanning material was given in two previous articles in the *Kew Bulletin* (1890, pp. 63-69, and 1894, pp. 167-168). A figure was given in 1895 in the *Botanical Magazine* (t. 7433). According to the following extract from the *Report for 1896 on the Trade and Agriculture of California* (Foreign Office 1897, Annual No. 1922), it is rapidly making its way as a tanning material for light leather.

"Canai gre is the American corruption of the Spanish "cana agria," sour cane. It is also called "Yerba-Colorado" in Mexico, localisms being "red dock" "tanner's dock," and "wild rhubarb." The best way to propagate the plant is by use of small roots rather than by seed. About 1,000 lbs. of tubers will plant an acre, and October and November are the best months for putting in the crop, though where irrigation can be practised, planting may be done at any time. The value of canai gre as a tanning agent, either alone or in connexion with other tannins, has been proved beyond question. For light leather it gives great tensile strength, and is far better for split leather than gambier, oak, or hemlock. It is a quick tanner, and the yellow colour absorbed by the hide in the process of tanning is considered highly desirable for certain leathers. The sliced and dried tubers, containing an average of 30 per cent. of tannic acid, are worth from 8*l.* to 9*l.* per ton. A yield of from seven to 10 tons per acre would give 2½ to 3½ tons of the dried product, for which there is a constant demand in Europe and America. Inasmuch as the plant grows wild in this vicinity, and the seed roots are readily obtained, the industry commends itself to the farmer of small means, as it is harvested in such a short period after planting."

DLIX.—EXTRACTION OF GUTTA PERCHA FROM LEAVES.

The following communication supplements the information already given in the *Kew Bulletin* (1891, pp. 231-239).

EXTRACT from letter from Director of Gardens and Forest Department, Straits Settlements, to Royal Gardens, Kew, dated Botanic Gardens, Singapore, September 18, 1896:—

"I have just been down to inspect the little factory where Mr. Arnaud makes his gutta-percha. Serullas has gone back to Paris with endless patents of different kinds, and Mr. Arnaud alone keeps up the business. The leaves are imported in sacks dry from Borneo and Johore. Most of the trees are overcut in Singapore, and there are no more leaves left, I hear. The leaves and twigs cost four dollars and a half a picul (133 lbs.) They are then put, damped with hot water, into a rolling machine, two rollers working against each other, which grind them to powder. The powder is thrown into tanks of water and shaken about. The gutta floats in the form of a green mealy-looking stuff, is lifted out by fine copper gauze nets, put in warm water and pressed into moulds. I have samples of the gutta as it comes out from the leaves, and the pressed out finished article. It is really a very curious little manufactory. I do not know how long it will last, on account of the difficulty of procuring leaves, which must, I think, sooner or later stop the trade."

DLX.—WINE PRODUCTION IN FRANCE.

In the *Report on the trade of Bordeaux for the year 1896* (Foreign Office, Annual Series, 1897, No. 1916), which has been communicated to Kew by the Secretary of State for Foreign Affairs, a striking picture is drawn of the effects of the phylloxera on the wine production of France, and of the various expedients which have been resorted to to make up the deficiency in production.

ANNUAL PRODUCTION.

“The annual wine production of France, which during the 25 years preceding the year 1879 amounted on the average to 1,100,000,000 gallons, a quantity sufficing both for the wants of home consumption in this country and for those of the export trade to foreign countries (about 65,000,000 to 75,000,000 gallons per annum), has since that time (in consequence of the ravages of the phylloxera and other vine diseases, as well as of unfavourable atmospheric influences during many years) declined to an average annual yield of about 725,000,000 gallons, a falling-off, therefore, of about 375,000,000 gallons per annum.

“In order to meet this deficiency France, as is well known, has been obliged to import largely foreign (more especially Spanish, Italian, Portuguese, and Dalmatian) wines, which are to some extent sold in their original state, but the far larger proportion are used for blending with the light French wines of the commonest class. These blended Franco-foreign wines find a ready market, as they are by no means always unpalatable, and often very fair (nor are they unwholesome, as they are, after all, mixtures of the pure juice of foreign and French grapes); they are served as so-called ‘vin ordinaire’ in a large number of even the better-class of hotels and restaurants all over France. On the other hand, however, the dearth of the cheapest kind of French wines, which in former times were abundant enough to be obtained even by the most modest purse, has given rise to a great development of the manufacture of artificial wines (made from raisins and other grape substitutes), and these find a ready market, especially amongst those poorest classes of the population who look more to the low price than to the quality of the liquor, of which they are accustomed to drink a large quantum. That in the Gironde, for instance, this daily quantum of wine is considerable amongst both the poorer and wealthier inhabitants is evident from the fact that the average annual consumption of wine per head of the population in this department amounts to 32·34 gallons.

ARTIFICIAL WINES.

“Though the importation of foreign wines and the manufacture of artificial wines had the natural effect of keeping the prices of the genuine French product on the whole at a low figure, their competition was not so seriously felt and complained of by the wine growers and merchants of this country so long as the supply of such foreign or artificial wines kept within the limits annually required for meeting the deficiency in French production.

“But of recent years the manufacture and sale of artificial wines in France, as well as the importation of foreign wines, have experienced such an extraordinary development that the genuine French article is now being driven out of the market, and wine growers and merchants every year find it more and more difficult if not impossible to dispose

of their accumulating stocks of red and white wines of good quality. Considering, moreover, that the majority of French vineyard owners have, during the last 15 years, spared no trouble and (when they could afford it) no expense in combating the many vine diseases, and, if necessary, in replanting the devastated vineyards, and that the sacrifices thus made are, to all appearance, certain to bear good fruit in the future, and will, at a not too distant date, bring to France a return of her former abundant wine production, it is evident that the gradual flooding of the markets of France and also foreign countries with foreign or artificial imitations of French wines must create considerable dissatisfaction amongst both vineyard owners and wine merchants in Bordeaux and other prominent wine-producing districts of this country. The French Government have, during the past year, in consequence, been strongly urged by the wine merchants and vineyard owners of the Gironde and other departments to apply the existing laws against fraudulent imitation of wine in a more vigorous manner, and in the interest of the honest trade to increase their stringency; and it has further been requested to take steps for raising the import duties on Spanish wines (and any other foreign wines not taxed so highly). A project of a new law dealing with this subject was submitted to the French Chamber last autumn and passed after certain modifications had been introduced.

PHYLLOXERA.

“An idea of the extent of the widespread damage caused by the phylloxera since its first appearance 17 years ago, in the more or less valuable vineyards of the Gironde Department, may be gathered from the fact that of the aggregate area of land planted with vines in the Gironde in the year 1879, which is officially estimated at 450,000 acres, only 81,820 acres have (owing apparently to the silicious nature of the soil) entirely escaped the incursion of this noxious parasite. The total area of the vineyards which have been more or less seriously infested has, up to this date, reached 368,200 acres. Of this large infested area 104,310 acres have been uprooted and replanted with American and Franco-American vines which are able to resist the attacks of the phylloxera; 49,807 acres of vines are subjected to a continuous preventive treatment which prevents the phylloxera from extending its destructive work, and 100,950 acres are, owing to the inability or unwillingness of the owners to defray the heavy cost of combating it, left to its mercy, and suffer of course seriously in their productiveness. But the remaining 114,100 acres of vine-growing land infested by the phylloxera since 1879 are no longer cultivated with vines, and are now either lying waste or have been converted into grass land.

“Thus the aggregate area of vineyards under cultivation in the Gironde at the beginning of the year 1896 was only 336,900 acres; figures showing a very large diminution compared with those given above for 1879. They moreover also show a small falling-off, namely of 8,375 acres compared with the figures for 1895, which was due to the fact that whilst 12,410 acres of diseased and unproductive vines were uprooted in 1895-96, the area of fresh vine plantations reached only 4,035 acres.

“Amongst the 336,900 acres of vineyards existing in this Department at the commencement of last year 104,310 acres consisted (as above stated) in fresh plantations gradually made since the date of the first appearance of the phylloxera; of these fresh plantations 5,212 acres were in American direct-producing vines, but by far the larger proportion, viz., about 98,000 acres, consisted in American vines grafted with

French plants. The extent of fresh plantations with these Franco-American vines has, of late years, been and is still steadily increasing, whilst those of direct-producing American vines are being gradually less resorted to. It is, however, pointed out by competent viticulturists that in spite of the success obtained by the former, great care should nevertheless be taken to select the right species of American vines for grafting upon, for if this be not done, the eventual success of the operation (though the first results may appear satisfactory) must be uncertain.

"The considerable expense of the preventive treatment of the vines (in order to combat the inroads of the phylloxera) by the various chemical remedies as well as by submersion of the vineyards under water, which latter method is indeed only practicable in some localities, and the generally favourable results attained by the fresh plantation, have gradually led vine proprietors to the conclusion that the least expensive way of combating the phylloxera is indeed to uproot the infested vineyards and to recultivate them with American vines grafted with French."

"There can now be no doubt that owing to the considerable increase in the value of a vineyard, consisting of vines which are thus not only able to resist the inroads of the phylloxera, but which are extremely productive, proprietors would in ordinary conditions soon find themselves repaid for their first outlay and trouble. Unfortunately, there is the existing difficulty, the competition of foreign and artificial wines, a circumstance which will render unprofitable, not to say disheartening, these and other efforts on the part of the sorely tried growers towards improving their property and increasing their wine production.

"It may be here observed that the total actual pecuniary loss caused up to the present time to the vineyard owners of the Gironde Department by the ravages of the phylloxera, arising both from a diminution in the area and the productiveness of vine growing land, is estimated at about 26,000,000*l.*, and that of the total cost incurred in reconstituting the devastated vineyards as well as in combating the spreading of the phylloxera at about 6,000,000*l.*, thus showing an aggregate loss of about 32,000,000*l.* to the viticulturists in this department alone. If the loss and expense occasioned by the phylloxera in all other wine-producing departments of France were added, it is probable that a total estimate considerably exceeding 100,000,000*l.* would be reached."

OTHER VINE DISEASES.

"The well-timed and preventive treatment of the vines with the 'Bouillie bordelaise' (see *Kew Bulletin*, 1888, 271), which with very few exceptions has now become a standing practice amongst growers, had the desired effect of keeping the vineyards free from mildew, a disease feared at one time almost as much as the phylloxera itself. On the other hand the kindred pest called blackrot showed itself in many parts of the Gironde, though the damage done by it was, in consequence of preventive treatment taken by growers, not so serious in 1896 as had been feared. Though the use of the 'Bouillie bordelaise' as a preventive against blackrot is of considerable value, no thoroughly efficacious remedy against this disease appears, in spite of continued elaborate experiments, to have yet been discovered."

DLXI.—UNITED STATES NATIONAL HERBARIUM.

The development and organisation of the most important botanical institutions of other nations is of especial interest to Kew, which is necessarily brought into close relations with them.

The following account of the United States National Herbarium at Washington, by Mr. F. V. Coville, Chief Botanist to the United States Government, is therefore reprinted from the *Botanical Gazette* for November 1896 (pp. 418-420) :—

“In view of an evident lack of correct information regarding the recent change in the custody of the National Herbarium, it has seemed desirable that a brief sketch of the present relationship and work of the division of botany of the United States Department of Agriculture and the herbarium be presented to your readers.

“During at least the past three administrations, covering a period of nearly 12 years, there has been a feeling among the authorities of the Department of Agriculture that the Division of Botany should be relieved of the custody of the National Herbarium, that institution having grown beyond a mere consulting herbarium to the dimensions of a great governmental repository of botanical collections, thereby becoming a fit charge for the Smithsonian Institution. As a result of negotiations between the two establishments, the herbarium was transferred about two years ago from the Department of Agriculture to quarters in the fireproof building of the National Museum, which is under the direction of the Smithsonian Institution, the department, however, continuing to furnish the money for its maintenance. But on July 1, 1896, the museum assumed complete charge of the Herbarium, being enabled to provide for it through an increase of \$10,000 in the appropriations of the museum, added by Congress for this special purpose. The disbursement of this sum for the National Herbarium is made, therefore, through the Smithsonian Institution. Two assistant curators, Dr. J. N. Rose and Mr. C. L. Pollard, have been transferred from the Department of Agriculture to the Museum, with the necessary clerical help, and a new assistant curator of the cryptogamic collections, Mr. O. F. Cook, appointed, the botanist of the Department of Agriculture, Mr. Frederick V. Coville, continuing to serve, without salary as curator. Provided with a force of ten people, in addition to the curator, situated in fireproof quarters and managed by the Smithsonian Institution, the National Herbarium is now favourably situated to continue its development as the repository of the botanical collections acquired by the various branches of our government.

“The Division of Botany in the Department of Agriculture has now a force of twenty persons, including clerks and labourers, and funds to the amount of \$29,000 available for the expenditures of the present fiscal year. Mr. Frederick V. Coville is botanist and chief of division and is especially engaged in work upon the native plant resources of the United States and upon the geographic distribution of plants. Mr. G. H. Hicks is assistant chief and has special charge of seed investigations and the laboratory equipped for that purpose. Mr. L. H. Dewey has charge of all matters relating to weeds, information about the damage done by them, their present distribution and means of dissemination, ways of holding them in check, and warnings about newly introduced species.

“Mr. V. K. Chesnut has charge of the pharmacological laboratory and conducts investigations on poisonous plants, more particularly those native species which are a common cause of poisoning in man or

domestic animals. Mr. A. J. Pieters has charge of the anatomical and photographic work of the division, and is conducting a special series of experiments on the germination of weed seeds. Mr. W. W. Tracy, recently appointed from the seed farm of D. M. Ferry & Co., has charge of greenhouse and outdoor tests of seeds and of the cultivation of native food and other economic plants. Mr. J. C. Dabney is assisting in experiments in seed selection, and is making studies of the effect of various chemicals upon germination. Mr. Sothoron Key has charge of laboratory germination tests, and is conducting practical trials of the relative merits of various kinds of laboratory apparatus. Mr. John B. Leiberg is carrying on the greater part of the field work connected with the special studies of the botanist. Mr. F. A. Walpole is the artist of the division, recently appointed after passing the highest examination among 21 competitors.

"The Division of Botany as at present organised is an establishment equipped with the best scientifically trained men obtainable, and with the best modern appliances for the investigation of agricultural botanical problems."

DLXII.—COMPLETION OF FLORA OF BRITISH INDIA.

The issue of the twenty-second part concluding the *Flora of British India* was recorded in the *Kew Bulletin* for December last. The following correspondence which has been officially addressed to Sir Joseph Hooker deserves to be placed on record as a recognition of his services in this and other fields of usefulness to India:—

INDIA OFFICE to SIR J. D. HOOKER.

SIR,

India Office, London, S.W.,

May 31, 1897.

I AM directed by the Secretary of State for India in Council to forward copy of a letter, in which the Government of India express their satisfaction at the completion of your *Flora of British India*. Lord George Hamilton desires heartily to associate himself with the Government of India in their acknowledgment of the valuable services you have done to India by this great work, and by your labour in the field of Indian botany, since you first visited that country nearly 50 years ago.

I am, &c.

(Signed) A. GODLEY.

Sir Joseph Hooker, K.C.S.I., C.B., F.R.S.

GOVERNMENT OF INDIA to SECRETARY OF STATE.

MY LORD,

Simla, April 21, 1897.

WE are informed by our Director of the Botanical Survey of India that the *Flora of British India*, which was begun by Sir Joseph Hooker some 25 years ago, has just been brought by him to completion. The value of the work as a contribution to pure science has already been appreciated and acknowledged by others who are more competent to speak in such a matter than ourselves. But we desire to express our hearty recognition of the service to India which Sir Joseph Hooker

has rendered by his monumental undertaking. He has for the first time brought the botany of the empire into a collective form and placed it upon a firm and lasting basis, thus completing the work which he began nearly half a century ago in the Himalayas. We would ask your Lordship to convey to Sir Joseph Hooker our high appreciation of his labours, and of their value and importance as systematising and adding to our knowledge of the vegetable productions of India; and our hearty congratulations upon having brought to a satisfactory conclusion a work to which he has devoted so many years of his life.

We have, &c.

(Signed) ELGIN.

G. S. WHITE.

J. WESTLAND.

J. WOODBURN.

M. D. CHALMERS.

E. H. H. COLLEN.

A. C. TREVOR.

The Right Hon.
Lord George F. Hamilton,
Her Majesty's Secretary of State
for India.

DLXIII.—MISCELLANEOUS NOTES.

In the premature death of Mr. J. THEODORE BENT, the distinguished traveller, geographical and botanical science have sustained a grave loss. It occurred suddenly just as he had reached London from his last expedition to Sokotra and Southern Arabia. A chill caught on the way home brought on acute pneumonia, and he died on May 5, at the early age of 45 years.

Mr. Bent and his wife, who was his constant companion, were intrepid travellers in the East, in Arabia, and in Africa. The interesting botanical results of their memorable journey to Hadramaut (in 1893-4), on which they were accompanied by Mr. William Lunt, a member of the staff of the Royal Gardens, are given in the *Kew Bulletin* for 1894 (pp. 328-343). Those of their second journey in Arabia Felix in 1894-5, were published in the *Kew Bulletin* for 1895 (pp. 180-186). The materials they obtained brought out clearly the relations of the Flora of Southern Arabia to Africa on the one hand, and to Western Asia on the other. They returned last winter to the same region, visiting in addition the island of Sokotra. But the plants they obtained have not yet been worked up.

Mr. Theodore Bent possessed a singular charm of manner, and an eager intelligence. His own object in travel was mainly archaeological. But he was keenly anxious to assist any other branch of science to which he could be of use.

Botanical Magazine for April.—The plants figured are *Agave Haseloffii*, *Gentiana tibetica*, *Tristania laurina*, *Gongora tricolor*, and *Senecio Smithii*. The *Agave* is a Mexican species which has been in cultivation at Kew for many years, and flowered for the first time in 1895. The *Gentiana* is a tall-growing species with leaves sometimes 18 inches long. The plant figured was raised from seed supplied by

the Royal Botanic Gardens, Calcutta. *Tristania laurina*, from Eastern Australia, has been grown at Kew for a considerable time, but the specimen drawn for the *Magazine* was furnished by Thomas Hanbury, Esq., of La Mortola. *Gongora tricolor* is a native of Costa Rica, whence the Kew plant was sent by the late Mr. R. Pfau. The fine *Senecio* was first discovered by Banks and Solander in Tierra del Fuego during Cook's first voyage. It has since been found in South Chili, and seeds, from which the plant figured was raised, have been sent to Kew from the Falkland Islands, where they had been collected by Mr. A. Linney, of the Government Gardens.

Botanical Magazine for May.—All the plants figured are in cultivation at Kew. *Agave kewensis*, from Mexico, flowered for the first time in the Royal Gardens in 1895. *Maxillaria houtteana* is a native of Guatemala and Venezuela. The plant figured was obtained from the Brussels Botanical Garden. *Syringa amurensis* is a privet-like plant from North China and Japan. Professor Sargent, who had introduced it from the latter country into America, sent plants to Kew. *Dimorphotheca Ecklonis* was raised from seeds supplied by Mr. William Armstrong, of Port Elizabeth, where it occurs wild. *D. Ecklonis* differs from all the other species figured in the *Botanical Magazine* in having a shrubby stem. *Gomphocarpus setosus*, native of Southern Arabia, has but little merit as a garden plant. Seeds from which the plant figured was raised were collected by Mr. Lunt during the Hadramaut Expedition in 1893.

Hooker's Icones Plantarum.—Parts one and two of the sixth volume of the fourth series (plates 2501-2550) have appeared. Two new genera are figured, namely, *Efulensia* (Passifloraceæ) and *Campylogyne* (Combretaceæ). The former is a native of West Tropical Africa, where it was discovered by our correspondent, Mr. G. L. Bates, and it is nearly allied to *Crossostemma*, differing in having compound leaves and free styles. *Campylogyne*, from the same country, had been erroneously referred to as *Cacoucia*. *Dorstenia arabica*, Hemsl., is a singular species having a fleshy stem and bullate, shining leaves. It was one of the discoveries of the late Mr. Bent. *Calvaria major*, Gaertn. f., is an exceedingly interesting sapotaceous type from Mauritius. Seeds of *C. hexangularis*, Gaertn. f., a species which has not been identified with any existing tree, were found embedded with bones of the Dodo. *Echinops bromeliaefolius*, Baker, is remarkable for its foliage and very long cylindrical receptacle. *Sacoglottis amazonica*, Mart. (Humiriaceæ), is the source of a "drift-fruit" figured and described three centuries ago. *Tradescantia orchidophylla*, Rose and Hemsl., has large orbicular leaves lying flat on the ground, and a few shortly stalked flowers clustered in the centre. *Glossostemon Bruguieri*, Desf., is a member of the Sterculiaceæ inhabiting Mesopotamia and the neighbouring countries, having a large spiny fruit, until now imperfectly known. Finally there is a series of about a dozen plates of figures of Mexican species of *Eryngium*, exhibiting a great range of variety in habit, foliage, involucre, and fruit, the last both in appendages and in cross-section.

Tibetan Plants—Two additional collections of dried plants have been received from Tibet, which is becoming more and more the field of active exploration. One of these was made by Captain Wellby and Lieutenant Malcolm during a journey across Tibet between 35° and 36° N. The other was obtained by Captain Deasy and Mr. Arnold Pike when travelling in Western Tibet. Both collections exhibit the stunted vegetation so characteristic of this flora. Selections from both have been exhibited at the Royal Society's *Conversazione*, where they attracted much attention.

Primula farinosa in the Andes.—The isolated position of a species of *Primula* in Tierra del Fuego and the Falkland Islands, whether regarded as specifically distinct from the northern *P. farinosa* or not, has been commented upon by most writers on botanical geography. Sir Joseph Hooker (*Flora Antarctica*, ii. p. 337) specially alludes to the absence of the genus, so far as then known, from all parts of the Andes, and the fact that no species had been found in North America in a lower latitude than 39°. Since then two species have been discovered in the mountains of Arizona and New Mexico, and now Prof. F. Philippi, the director of the botanic garden at Santiago, has sent specimens of the South American species from two distant localities in the Chilian Andes. One is from the Cordillera del Rio Manso in 41° 30' S. lat., and the other from the Cordillera de Araucania in 39° S. lat. But Kew previously possessed a specimen of *Primula farinosa* from Chili, though the fact seems not to have been recorded before. This specimen was collected by Mr. Pearce, a traveller in the service of Messrs. James Veitch & Co., in the Cordillera de Ranco, midway between the other two localities, and was presented to Kew in 1884.

The South American specimens represent both large and small-flowered varieties; one of those from the Andes having flowers nearly or quite an inch in diameter.

Ceylon Flora.—The untimely death of Dr. Trimen unhappily left his admirable *Handbook to the Flora of Ceylon* in an unfinished state. Two volumes still remain to be written in addition to the three already published. Sir Joseph Hooker has most generously offered to undertake the preparation of these, and his offer has been accepted by the Government of Ceylon. The necessary materials and specimens have already been received at Kew from the Royal Botanic Garden, Peradeniya. More than thirty years ago Sir Joseph Hooker assisted Dr. Thwaites in his *Enumeratio Plantarum Zeylanicæ*.

Aids to Colonial Development.—The following is an extract from an article which appeared in the *Journal des Débats* for March 20 last, and of which a translation appeared in the United States Consular Reports for May (pp. 162-163):—

“A nation that desires to form colonies will find that the conquering of the territory is hardly the beginning of her task. The resources of the country must be studied and appraised; the agricultural and geological map of the land must be prepared; the soil must be analyzed, native

plants catalogued, foreign ones introduced, the best selected, and, finally, methods adopted to in every way advise and assist the colonists.

"The botanical gardens of our colonies were formerly rich in plants and cuttings, which were generously distributed. Unfortunately, the same cannot be said to-day, and our rivals (England and Holland) could teach us useful lessons. The Dutch have organized at Buitenzorg, Java, a first-class establishment, where plants are cultivated whose products can be used in the industries, such as rubber and camphor trees, gum plants, &c. These are introduced into the neighbouring Dutch colonies. Laboratories have been established, pamphlets are published, and photographs prepared to advertise the useful plants of the colonies and their products.

"The English have accomplished still more. The large botanical garden at Kew, known all over the world, is in correspondence with eighty similar establishments in English possessions—India, Guiana, Canada, Ceylon, &c. From each Kew receives plants, seeds, &c., which are cultivated with great care, not only in samples, but in sufficient number to be sent later to other colonies. The Germans, at Berlin, and the Belgians at Jembloux, have similar institutions.

"There is nothing more difficult than to transport plants, and, on the other hand, nothing more useful. The majority of industrial productions which constitute to-day the wealth of colonies are imported. Is coffee cultivated only in its cradle, Arabia? Has not the cacao tree, first found in Mexico, been carried to Java, and the vanilla plant, of the same place, to Réunion. The advantage of transporting jute, now the monopoly of India, rubber, quinine, gum, and clove-producing trees, as well as ornamental plants, to climates where the conditions would be favourable, is obvious. It will be found, however, that very few seeds retain their germinative quality long enough to permit a change of locality, especially when the voyage is of some duration, for instance, from Indo-China to the Antilles or the Congo. The plants themselves are too delicate to be transported. A botanical garden that can receive them and allow them to recuperate, as it were, from the voyage, before continuing to their destination, is indispensable to scientific agricultural development of the colonies."

Fodder Plants in British Guiana.—In the Report for the year 1895-6 by the Superintendent of the Botanic Gardens at Georgetown, British Guiana, attention is drawn to the unsuitability of Alfalfa, the Spanish name of the plant known in this country as Lucerne (*Medicago sativa*) for cultivation in tropical countries. The experiment in British Guiana entirely failed. This is confirmed by trials in similar situations in other parts of the tropics. On the other hand interesting particulars are given of crops that have been entirely satisfactory. These are described as follows:—

A plot of Bahama grass (*Cynodon Dactylon*, Pers.) taken from one of the lawns, that had never been manured, in 12 mowings in the year, gave an aggregate of 22 tons an acre.

Para grass (*Panicum muticum*, Forsk., *P. barbinode*, Trin.) that had been reaped on the same ground for several years in succession, without manure, ploughing, or replanting, in five mowings in the year gave 41½ tons per acre.

Guinea grass (*Panicum maximum*, Jacq.) on a rich piece of land, though not specially prepared for this trial, gave in five crops in the year, 107 tons per acre.

Maize in two crops for the year gave nine tons per acre. This was specially sown.

A highly nutritious native pea plant, *Phaseolus semi-erectus*, L. (widely distributed in tropical America) of which cattle are ravenously fond, gave, self-sown, without cultivation, in two crops in the year, a total of over 27 tons per acre.

Alfalfa (*Medicago sativa*, L.) in two crops for the year, gave only a total of 400 lbs.

The Rose of Jericho.—The plant commonly known as the Rose of Jericho is *Anastatica hierochuntica*, L., and that it has borne that name for centuries is proved by the fact that it is figured and described as such by nearly all the early herbalists. Lonitzer (*Lonicera*), the first edition of whose *Kreuterbuch* appeared in the middle of the sixteenth century, writes of it as a well known foreign herb, bearing the names Rosen von Hiericho, Rosa Hierichuntis, Rosa S. Mariæ, and Rosa Hierosolimitana. Several other sixteenth century authors write more fully on it. But it is now claimed that *Asteriscus pygmaeus*, Coss. et Dur. (Compositæ), is the true Rose of Jericho. The Abbé Michon, who accompanied De Sauley on his travels in the East, describes (*Voyage Religieux en Orient*, vol. ii., p. 383) a plant under the name of *Saulcyia Hierochuntica*, which he regarded as the true Rose of Jericho of the pilgrims of the Middle Ages, because it is introduced into the arms of several French noble families. Boissier (*Flora Orientalis*, iii., p. 179) identified *Saulcyia* with *Asteriscus*, and cites Michon's opinion as to its being the true Rose of Jericho. Here the matter rested apparently until 1882, when Dr. P. Ascherson brought the subject before the Botanischen Vereins der Provinz Brandenburg (*Verhandlungen*, xxiii., p. 44). More recently (1886) Dr. G. Schweinfurth has written on "La Vraie Rose de Jericho" (*Bull. de l'Inst. Egypt.*, 2^{me} série, n. 6, pp. 92–96), where, according to Just (*Bot. Jahresber.*, 1886, 2. p. 196), he recognises *Asteriscus pygmaeus* as the plant. This covers a wider geographical area than the *Anastatica*, ranging from Algeria to Baluchistan, and it is very abundant in the neighbourhood of Jericho. In *Asteriscus* it is the involucreal leaves especially that are hygroscopic, being closely incurved over the fruit in a dry state and quickly opening out to an almost horizontal position under the influence of moisture.
